

Summary report – 2009 summer field activity

## Evaluating the feasibility of Crested Auklet enhancement via habitat restoration at Gareloi Island, Aleutian Islands

For

Keesal, Young & Logan  
&  
Polaris Applied Sciences

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The Selendang Ayu Trustee Council has requested advise on mitigation actions to restore seabirds impacted directly by the Selendang Ayu oil spill of December 8, 2004. Thousands of Crested Auklets (*Aethia cristatella*) are believed to have died as a result of the spill. Improving Crested Auklet breeding habitat is a possible option for restoring natural resources damaged by the spill.

This report discusses an experiment to evaluate the effectiveness of direct enhancement of breeding habitat structure at an active auklet colony. Auklets (*Aethia* spp.) nest in rock crevices produced by coastal erosion (talus slopes and beaches) and in blocky and porous lava flows (<http://www.mun.ca/serg/AAHab.html>). In the Aleutian Islands, where most of Alaska's Crested Auklets nest, colony sites occur on recent lava flows and talus. Re-vegetation of exposed rock (plant succession - <http://www.mun.ca/serg/succession1.html>) occurs within decades of a lava flow or seismic event, covering and eventually rendering a site unsuitable for auklet nesting activity. Auklets are therefore limited by the amount of freshly exposed rock with suitable crevices (they are unable to dig their own breeding sites), especially in the Aleutians that are at the southern limit of their breeding range and subject to a mild wet climate that facilitates plant growth. Kiska Island (major lava dome eruption 1966-1968) has the largest patch of fresh lava of any auklet colony in the Aleutians, but has introduced Norway rats (*Rattus norvegicus*) that predate auklets, sometimes severely. Rat-free Gareloi Island (many auklets nesting in lava from a 1938 eruption) has the next largest amount of suitable habitat, mostly covered with advancing vegetation Jones and Hart 2006).

This report describes the first phase of a project to test the effectiveness of direct modification of habitat at the Gareloi Island auklet colony – i.e., by creating new rock crevice habitat at a colony affected by advanced plant succession. An assumption is that breeding habitat is limited at Gareloi due to encroachment of vegetation, preventing some Crested Auklets from nesting. We are testing the hypothesis that provision of new suitable breeding habitat at the colony site will produce extra Crested Auklets to replace those killed by the oil spill.

This report briefly summarizes fieldwork at Gareloi Island during June 12 – August 11, 2009.

The aims of this part of the project included: 1) find and mark Crested Auklet study plots at the Southeast Colony for experimental habitat restoration; 2) measure Crested Auklet activity on the study plots, including surface attendance, estimate of number of individuals breeding and number of visible breeding sites, and 3) describe the vegetative characteristics and auklet nesting densities within the study plots. Ultimate aims of the project (future work in 2010 and onwards) will be 4) to measure relative movement of breeding and non-breeding Crested Auklets from the existing colony to the experimentally modified habitat, 5) to measure the (net) number of new Crested Auklet breeding opportunities created, 6) (using population models) infer the number (bird-years) created, and 7) to thereby determine the viability, form and extent of habitat enhancement required to replace the Crested Auklet bird-years lost due to the Selendang Ayu oil spill.

## **Methods**

### **A. Study Plot Establishment**

To establish study areas in which Crested Auklet responses to vegetation manipulation could be maximally assessed, four 10m x 20m 'moderate density' study plots were established along the edges of the Gareloi SE colony in areas of moderate bird density, each divided into two halves and delineated so that both halves were similar to each other in terms of vegetation and surface characteristics, as well appearing to have a similar occupation by Crested Auklets (based on preliminary observations of surface activity). One half of each plot (randomly selected) was experimentally de-vegetated by the manipulation crew during autumn 2009, and the other half (left undisturbed) will serve as the control. To attempt to identify unoccupied sites areas that would maximally benefit from vegetation manipulation, an additional four 10m x 10m plots were delineated on areas of the hillside and valley adjacent to the colony in areas that were 100% vegetated and that had little to no auklets using the area for breeding ('unoccupied plots'). Small portions of vegetation were stripped away to check for suitable breeding habitat under the vegetation, and all four plots were set up in areas that appeared to contain some lava substrate with potential nesting habitat. These 10m x 10m plots were also divided into quadrants to quantify vegetation characteristics.

Additionally, the plots were assessed for the percentage of habitat within the plot that could have potentially been used by breeding auklets the 2009 breeding season.

## **B. Nest Mapping**

To quantify Crested Auklet breeding activity inside each moderate density plot, we located Crested and Least Auklet active breeding sites ('nests', indicated by the presence of an incubating adult or an egg in an appropriate location) within the plot boundaries and marked these on hand drawn maps. Nests were found by checking every accessible crevice inside the plot from early June through late-July. 'See Snake' devices (handheld video/camera hose) were used to view difficult-to-see crevices. As the colony substrate is composed of porous lava rock, we suspected that only a small proportion of nests on any plot would be directly visible, but that the number and location of nests found would provide a valuable measure for before/after comparisons.

## **C. Capture-Mark-Recapture: Banding**

In order to quantify numbers of individuals using the 'moderate density' study plots before manipulation, Crested Auklets were trapped with noose carpets as early as possible in the study period. Trapped birds were fitted with a unique combination of three Darvic colored plastic leg bands and assessed for sex, age and breeding status (*via the presence or absence of a brood patch*). Basic morphometrics (*culmen length and bill depth*) were also recorded to infer the sex of the bird (Jones 1993). We aimed to trap and band approximately the same number of Crested Auklets in both halves of each 'moderate density' plot.

### **Capture-Mark-Recapture: Surface Counts**

In order to estimate the population of Crested Auklets using each plot, we measured the ratio of banded to unbanded birds seen on the surface of each plot (Table 5). Since the number of marked birds present was known, this ratio may provide an estimate of the number of individual birds using an area. We conducted as many counts as possible on each plot, to obtain a mean value of the ratio that best reflected the true proportion of Crested Auklets on each plot. Counts of banded to unbanded individuals were taken every 10 minutes for a

typical span of 3-6 hours during the morning or evening activity period (and sometimes both). The number of Crested Auklet individuals using the surface of each plot  $N_{\text{surface}}$  was then estimated as:

$N_{\text{surface}} = \text{number marked and resighted at least once} \times (1 / (\text{mean decimal proportion observed marked during resighting activity}))$

#### Capture-Mark-Recapture: Count of Breeders

In order to estimate the number of breeding individuals using each plot, we measured the ratio of banded to unbanded *breeders*. 'Breeders' were identified as Crested Auklets arriving at each study plot with a chick meal (distended throat pouch and 'choking' behavior), which were easily identified through scope or binoculars (note that this method does not detect breeding individuals whose effort failed during the incubation or early chick-rearing stage). Any marked individual seen delivering food at least once was identified as a 'breeder', and the total number of breeding individually marked birds was determined for each plot by watches through the chick rearing period. Cumulative counts were performed continuously for three hours during the morning and evening activity periods. The number of Crested Auklet individuals that reached the chick rearing stage  $N_{\text{breeders}}$  on each plot was then estimated as:

$N_{\text{breeders}} = \text{number of marked birds seen delivering food at least once} \times 1 / (\text{mean decimal proportion of marked to unmarked birds delivering a chick meal})$

For each plot, the number of active breeding sites (i.e., breeding pairs) that reached the chick rearing stage was thus estimated as half the number of individuals delivering chick meals (Table 5).

#### Capture-Mark-Recapture: Resighting Band Combinations

Banded auklets were resighted (i.e., bands read and all band combinations observed noted down) for three hours daily during the morning or evening activity periods in conjunction

with surface counts. We noted which plot half each banded bird was sighted for each resight. This information in combination with resights from next season (after the manipulation) will help quantify movement of birds between the control and manipulated halves of each study plot as well as movement among plots.

#### **D. Surface Activity: Reconyx Images**

A time-lapse Reconyx camera was set up outside each plot (4 total) to record surface activity. The cameras were programmed to take photos every 5 min. from 1000 – 1700 h from July 5 to 14, 2009 and from 1000 h – 0000 h from July 16 to 28, 2009. The maximum number of Crested Auklets on the surface of each plot was recorded, along with a timestamp, for each day in each plot.

### **Results**

#### **A. Study Plot Establishment**

To establish study areas in which Crested Auklet responses to vegetation manipulation could be maximally assessed, four 10m x 20m ‘moderate density’ study plots (A, B, C, and D, Fig. 1) were established (no areas of low density were found within the colony close to the beach): **A** 51.7544°N 178.7567°W (all in datum WGS 84), **B** 51.7540°N 178.7569°W, **C** 51.7543°N 178.7581°W, **D** 51.7540°N 178.7586°W (coordinates are for the northeast corner of each plot). Plots were chosen to include the most highly vegetated areas found, but there were no areas in the SE colony close to the beach (accessible to the manipulation crew) that were 100% covered in vegetation, due to the exposed sides of some large rocks and hummocks. Despite this, vegetation cover was substantial and each chosen plot was between 86% and 91% covered in vegetation (Table 1). Each plot half was divided into quadrants (eight 5m by 5m sections) for both vegetation and nest surveys. The majority of the vegetation in the study plots comprised of a tall grass of the *Calamagrostis* or *Poa* genus, and with compacted areas of short grass (*Puccinellia* spp.), the surface of the latter used as socializing, landing and take-off pads for both Crested and Least Auklets (Table 1). To attempt to identify unoccupied sites areas that would maximally benefit from vegetation manipulation, an additional four 10m x

10m plots (E, F, G, and H) were delineated on areas of the hillside and valley adjacent to the colony in areas that were 100% vegetated and that had little to no auklets using the area for breeding: E 51.75445°N 178.7567°W, F 51.7547°N 178.7572°W, G 51.7547°N 178.7578°W, H 51.7544°N 178.7581°W ('unoccupied plots', coordinates from the northeast corner of each plot). Small portions of vegetation were stripped away to check for suitable breeding habitat under the vegetation, and all four plots were set up in areas that appeared to contain some lava substrate with potential nesting habitat. These 10m x 10m plots were also divided into quadrants to quantify vegetation characteristics (Table 2). Additionally, the plots were assessed for the percentage of habitat within the plot that could have potentially been used by breeding auklets the 2009 breeding season. These plots were set up at the end of the field season (late-July) after most of the chicks had already fledged, so it was not possible to conduct a thorough nest search, but the majority of the area of all of these plots was too vegetated to be currently occupied by any nesting auklets (Table 2).

## **B. Nest Mapping**

Nests were found by checking every accessible crevice inside the plot from early June through late-July (Plots A and D were not checked by See Snake as one of our units failed due to electrical problems). As the colony substrate is composed of porous lava rock, we encountered a honeycomb-like matrix of tunnels and crevices in the lava rock, so obviously not every crevice could be accessed. It was likely that there were numerous nests as far as 5-8 m below the surface of the colony in this area, so only a small proportion of nests on any plot were directly visible. At each located nest, species (Least or Crested Auklet), nest content and nest substrate was recorded (Table 3) and the nest was mapped onto a plot map (Appendix 1). Number of visible nests provides a measure of occupancy that will be used for before and after manipulation comparisons.

## **C. Capture-Mark-Recapture: banding, resighting, surface counts and ratios**

A total of 614 Crested Auklets was trapped with noose carpets and color-banded during the period June 22 to July 2, 2009 (on plot A: 153, B: 154, C: 152, D:155) (Table 4). Forty six percent

of the marked birds were later resighted at least once.

Surface counts of banded and unbanded Crested Auklets were performed as soon as banding was completed (July 3, 2009) until the surface activity dropped so low as to make the count unproductive (July 26, 2009). The mean proportion of banded (marked) birds standing on the surface of each plot was as follows: A: 0.02, B: 0.03, C: 0.03, D: 0.03. Thus the number of individuals using each plot ( $N_{\text{surface}}$ ) was estimated as: A: 4600, B: 2033, C: 1967, D: 2333 (Table 4).

To obtain an estimate of the proportion of breeding birds that were marked, cumulative counts of Crested Auklets (banded and unbanded) delivering chick meals were performed continuously for three hours during the morning and evening activity periods (sometimes both) from July 3, 2009 until July 26, 2009. The mean proportion of banded (marked) birds among Crested Auklets delivering food was as follows: A: 0.05, B: 0.04, C: 0.06, D: 0.04. Thus the number of individuals 'breeding' on each plot ( $N_{\text{breeders}}$ ) was estimated as: A: 1100, B: 750, C: 600, D: 375 (Table 4) and number of nests (pairs) as: A: 550, B: 375, C: 300, D: 188.

#### **D. Surface Activity: Reconyx Images**

The maximum number of Crested Auklets on the surface of each plot for each day (Fig. 2) dropped off colony-wide starting about July 12, 2009. There was also a two-week bout of inclement weather with very strong winds and rain in mid to late July that was associated with lower surface activity.

#### **Discussion**

The field crew successfully delineated eight study plots (four referred to as 'moderate density' and four 'unoccupied') according to the protocol developed with input from our collaborators. The area of the southeast colony chosen for plot selection was that close to the shoreline, overlapping and within the eastern limits of the high density (red dots on plot map, Jones and Hart 2006, Fig. 1). The rationale for selection of this area emphasized two objectives: 1) ease of access to the shoreline and a potential landing beach for equipment that



might be used in habitat modification, and 2) presence of nesting Crested Auklets in areas of moderate to complete overgrowth of the colony site by vegetation. Areas of heavy vegetation overgrowth blocking Crested Auklet access to underlying porous lava (or other geological features providing crevices suitable for nesting) would provide optimal opportunity for habitat modification to restore Crested Auklets.

Among the four 'moderate density' plots selected, two (A and B) were located close to survey plots (Jones and Hart 2006) classed as medium auklet density (11-100 active nests per 100 m<sup>2</sup>), one (C) was close to the colony boundary delineated in 2006 and approximately equidistant from a high density (>100 active nests per 100 m<sup>2</sup>) and low density (1-10 active nests per 100 m<sup>2</sup>), and one (D) was located almost exactly at the location of a high density plot (>100 active nests per 100 m<sup>2</sup>) from the 2006 survey.

Forty six % of the 614 Crested Auklets color-marked on the four plots were resighted at least once on the plots. This proportion reflects the proportion of birds marked that were plot residents, and also was likely to be affected by observer effort and tendency of birds to stand visibly on the surface (and thus have their color marks read). A resight rate of 46% was somewhat lower than the proportion expected based on studies at Buldir and Kiska (ILJ), but probably reflects two factors present at Gareloi: 1) deep complex porous underlying habitat with a lack of suitable display rocks on the surface for birds to stand around on and show their marks, and 2) limited time for the four observers to deploy resighting effort (more effort = higher resight proportion expected). The Reconyx camera data suggest the first factor may have been most important, as peak numbers recorded standing (e.g., 49 birds for Plot A) were low relative to the total numbers of individuals present. Nevertheless, the capture-mark-resight (CMR) data obtained was of sufficient quality to estimate numbers of birds present on the four plots (A: 4600, B: 2033, C: 1967, D: 2333, Table 4). These numbers suggest the study plots all had high densities of Crested Auklets. Estimated numbers of breeding pairs (A: 550, B: 375, C: 300, D: 188) were also indicative of high densities of nesting Crested Auklets. Comparing the estimated number of breeding pairs to nests actually found during nest searches suggested that about  $\frac{1}{4}$  of nests on each plot were visible, except for plot D in which

more nests were found than predicted by CMR (A: 550/138 (25% of 'nests' found), B: 375/97 (26% of 'nests' found), C: 300/84 (28% of 'nests' found), D: 188/216 (more nests found than CMR prediction!)). The observation of more nests found than predicted by CMR at plot D suggests the presence of nocturnally active or otherwise unmarkable and unresightable individuals – hence the use of multiple methods of estimating Crested Auklet numbers.

At a productivity level (chicks fledged per nest per breeding season) of 0.5, Crested Auklet chick production at the study plots would be A: 275, B: 188, C: 150, D: 94 (based on CMR derived estimates on nest number. Expressed as chicks produced per 100 m<sup>2</sup> of colony surface area this is A: 138, B: 94, C: 75, D: 47, or on average 88 fledged chicks per 100 m<sup>2</sup> of colony surface area in this area of the Southeast Colony, Gareloi Island. This shows remarkable correspondence to the density estimates from Jones and Hart's (2006) survey.

Crested Auklet density at the four capture-mark-resight (CMR) plots was very high – these turned out to be as high density areas as are thought to occur at any Aleutian Auklet colony. Are such sites likely to benefit (in terms of increased Crested Auklet chick production) from habitat modification? If removal of surface vegetation and soil allows birds access to crevices previously inaccessible then numbers of birds nesting would be expected to increase in 2010. If removal of surface vegetation and soil destroyed some nest sites, failed to give access to new sites, or indirectly caused disturbance to breeding birds then numbers of birds nesting would be expected to decrease in 2010. Our BACI experimental design was devised to test which of these possibilities is correct for the plots selected and habitat modification employed – the answer will be available upon completion of 2010 fieldwork, with the following measures for before-after comparisons for each of plots ABCD:

Maximum daily surface counts of Crested Auklets (Reconyx cameras)

Count of visible Crested Auklet active nest sites (nest search)

CMR estimate of number of individual Crested Auklets using each plot ( $N_{\text{surface}}$ )

CMR estimate of number of Crested Auklets nesting on plot ( $N_{\text{breeding}}$ )

CMR estimate of movement onto manipulated half of plot

As an additional option:

Productivity (chicks fledged per nest)

If habitat modification turns out to increase chick production by 5%, then an extra production of 4 chicks per 100 m<sup>2</sup> of habitat modified per year would be expected, based on all the assumptions made for the calculations above. We believe habitat modification is likely to be more effective if employed at sites with greater vegetation/soil cover and lower auklet nesting densities (i.e., 1-10 breeding pairs per 100 m<sup>2</sup>) than plots ABCD. Habitat modification at the unoccupied plots EFGH would be expected to be more effective, if these sites' underlying geology includes crevices suitable for Crested Auklet nesting.

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### **References**

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Jones, I.L. and K.A. Hart. 2006. A survey of inland Least and Crested Auklet breeding colonies at Gareloi Island in the Delarof Islands, Aleutian Islands, Alaska during 2006. Unpublished report for AMNWR, 31 pp. (downloadable at: [http://www.mun.ca/serg/Gareloi\\_REPORT.pdf](http://www.mun.ca/serg/Gareloi_REPORT.pdf))

**Table 1.** Ground cover on the ‘moderate density’ 10m x 20m plots A, B, C and D, at Gareloi Island in 2009.

Substrate	Plot			
	A	B	C	D
Bare rock	9%	14%	9%	9%
<i>Calamagrostis</i> sp.	74%	57%	80%	65%
<i>Puccinnellia</i> sp.	14%	25%	7%	25%
<i>Angelica lucida</i> Sea Angelica	2%	3%	3%	1%
herb (chickweed?)	-	<1%	<1%	-
<i>Achillea millefolium</i> Yarrow	-	<1%	-	-
<i>Gymnocarpium</i> sp. fern	1%	1%	1%	-
mosses	present	present	present	absent

**Table 2.** Ground cover, and % area suitable for auklet nesting, on the ‘unoccupied’ 10m x 10m plots E, F, G and H, at Gareloi Island in 2009. These four plots outside the boundaries of the colony represented a more diverse pool of plant species than inside the colony, which was dominated by grasses.

Substrate	Plot			
	E	F	G	H
Bare rock	-	-	-	-
<i>Calamagrostis</i> sp.	97%	76%	44%	78%
<i>Puccinnellia</i> sp.	<1%	11%	1%	10%
<i>Angelica lucida</i> Sea Angelica	3%	3%	3%	2%
<i>Achillea millefolium</i> Yarrow	-	-	1%	-
<i>Gymnocarpium</i> sp. fern	-	-	-	-
mosses	-	-	7%	-
<i>Lupinus nootkanensis</i> Nootka lupine	-	8%	19%	4%
<i>Empetrum nigrum</i> Crowberry	-	2%	24%	6%
<i>Dactylorhiza aristata</i> Keyflower	-	<1%	-	-
<i>Anaphalis margaritacea</i> Pearly Everlasting	-	<1%	1%	-
Area of plot suitable for auklet nesting	3.75%	1.25%	4.25%	5.0%

Table 3. Nest count and nest site substrate for plots A-D at Gareloi Island in 2009

Plot half	'Nests' found			'Nest' substrate			
	CrAu	LeAu	Unknown sp.	rock	mud	grass	mud/rock
Aa	75	31	13	97%	1%	2%	-
Ab	63	21	8	99%	1%	-	-
Ba	55	10	7	93%	4%	-	3%
Bb	42	12	12	100%	-	-	-
Ca	50	30	2	91%	8%	2%	-
Cb	34	10	2	91%	8%	2%	-
Da	108	13	13	93%	-	8%	-
Db	108	27	8	98%	-	2%	-







Table 4. Estimated population parameters, for plots A-D at Gareloi Island in 2009, using Capture-Mark-Recapture (CMR) methods

Plot	CrAus marked	CrAus resighted >1 time	Observed proportion standing that were banded	<b>Estimated number using plot</b> $N_{\text{surface}}$	CrAus sighted with food >1 time	Observed proportion with food that were banded	<b>Estimated number of breeding birds</b> $N_{\text{breeders}}$ (pairs)
A	153	92 (60%)	0.02	4600	55	0.05	1100 (550)
B	154	61 (40%)	0.03	2033	30	0.04	750 (375)
C	152	59 (39%)	0.03	1967	36	0.06	600 (300)
D	155	70 (45%)	0.03	2333	15	0.04	375 (188)
all	614	282 (46%)					

## Figure Captions

Fig. 1. Map showing locations of 'moderate density' plots A-D (black dots and lettering) and 'unoccupied' plots F-I (purple dots and lettering) at Gareloi Island, Alaska, superimposed on the Southeast Colony auklet colony map from Jones and Hart (2006, red dots - high density, orange - medium density, yellow - low density, small black dots - absent).

Fig. 2. Maximum daily surface counts for Crested Auklets at plots A (dark blue), B (purple), C (yellow), D (light blue) at Gareloi Island, Alaska during July 5 - 25, 2009. Maximum surface counts were obtained from Reconyx images every 5 min. from 1000 h to 1700 h daily. Study plots were divided into two equal halves and surface counts for each half were also recorded (not shown).

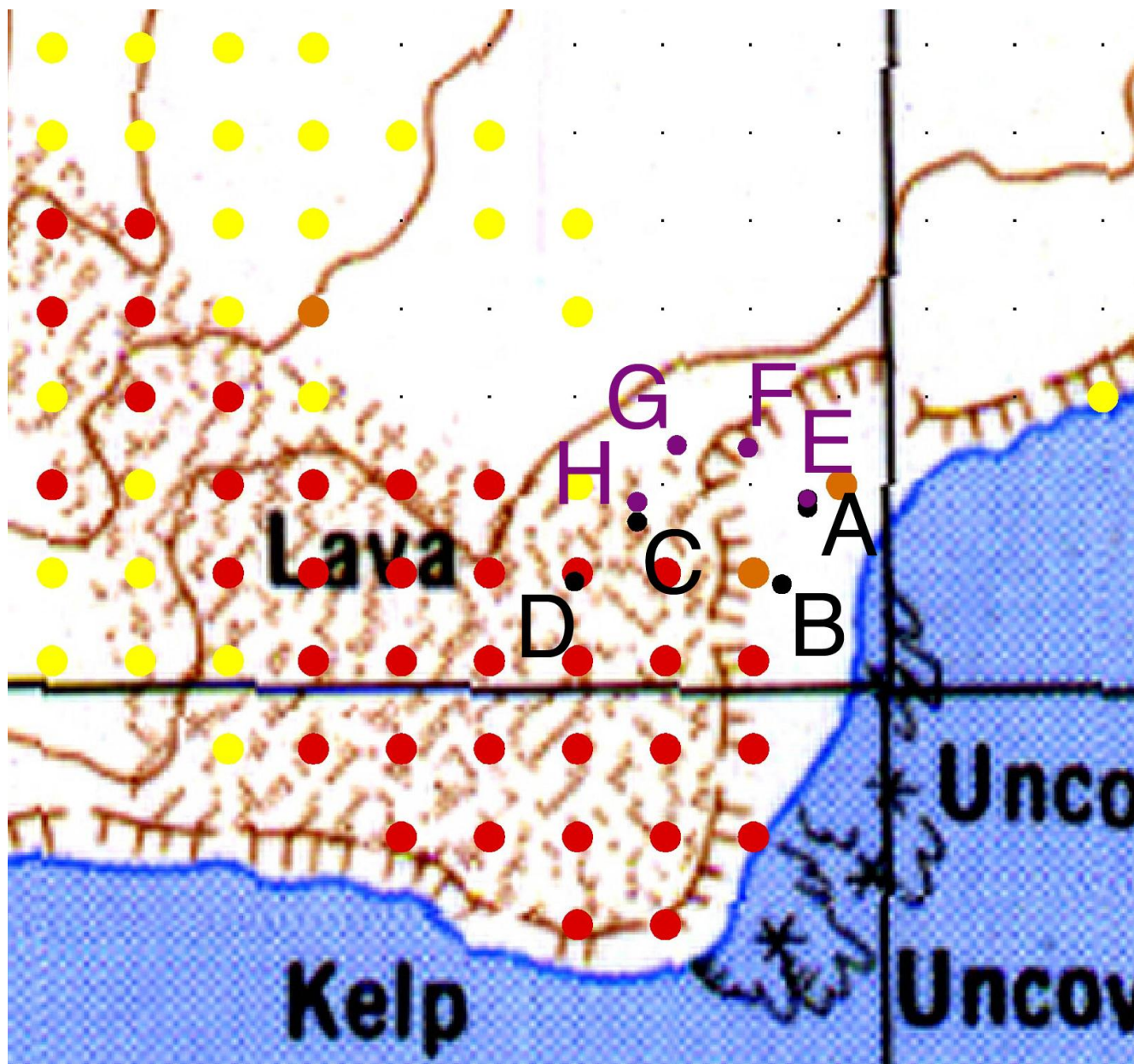


Fig. 1

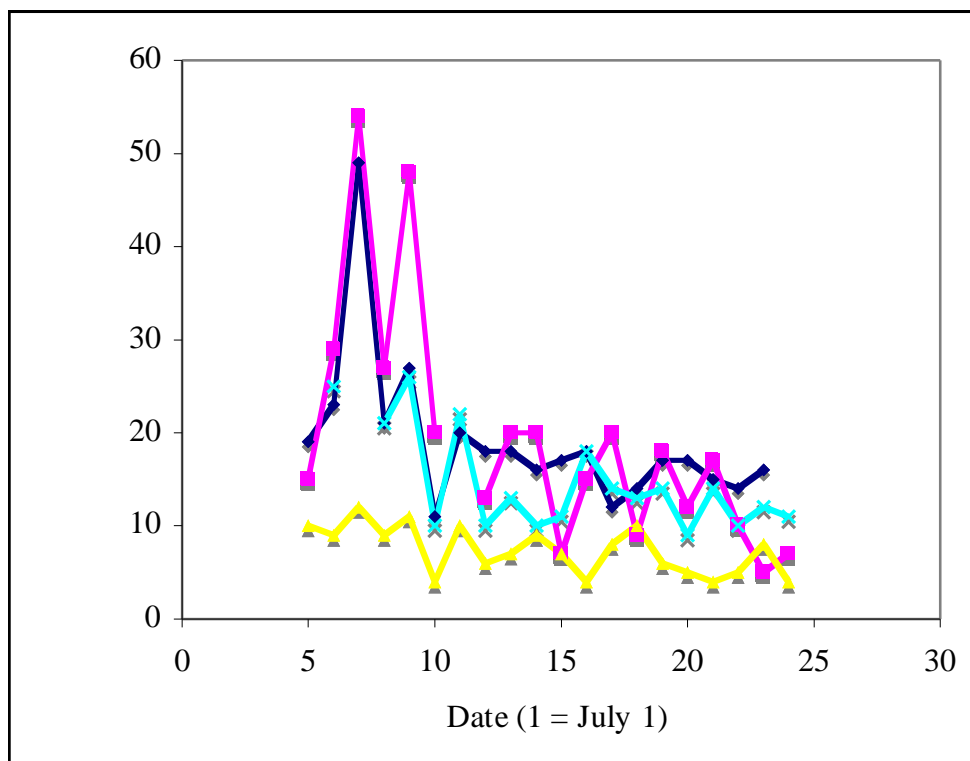
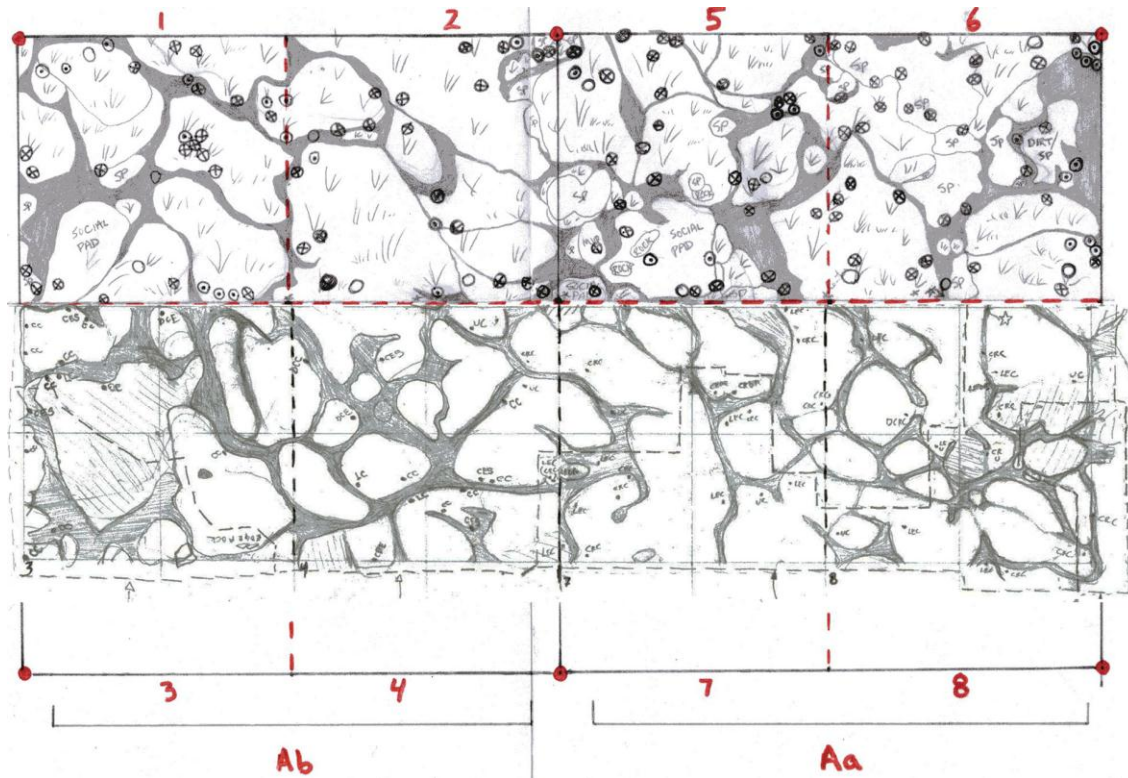


Fig. 2

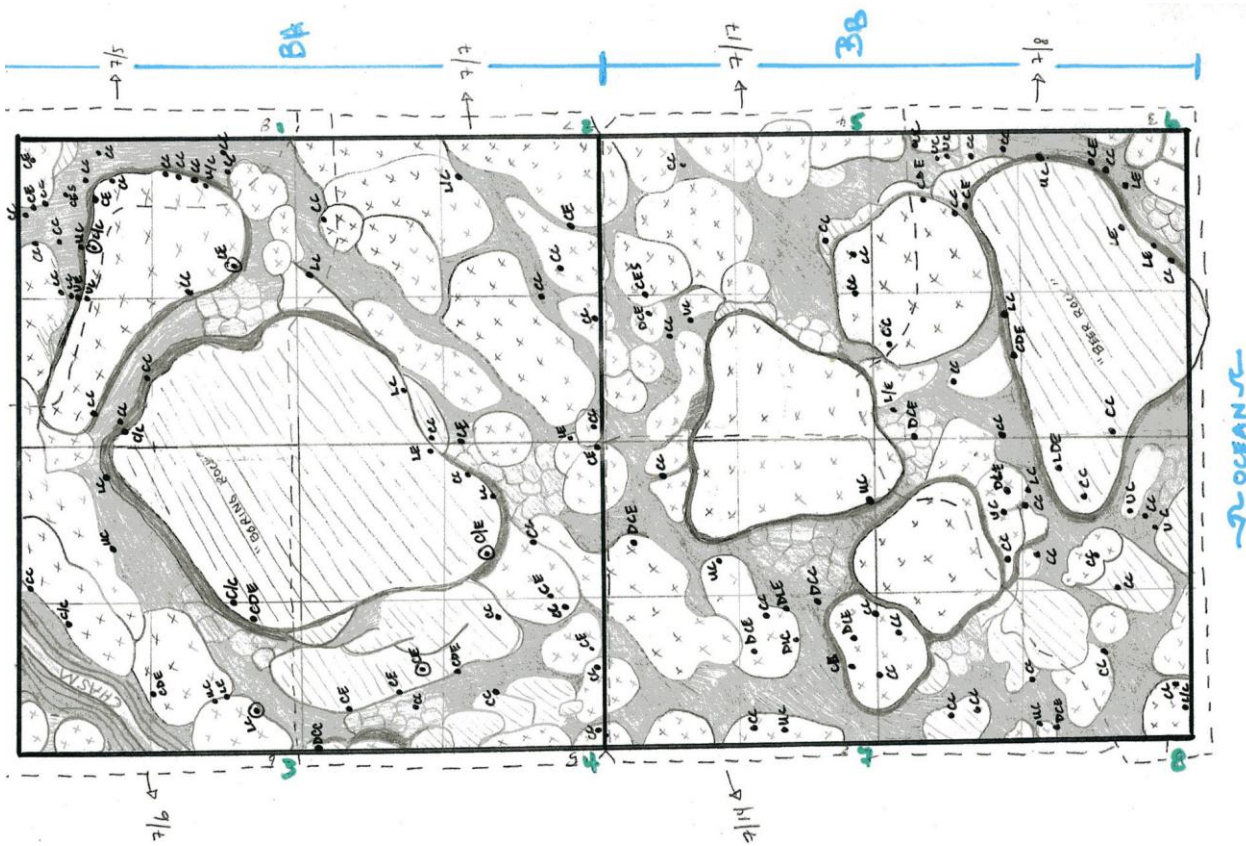
## Appendix 1 Moderate density plot A, B, C, D nest maps, for Gareloi Island in 2009

Plot A



Plot B





A hand-drawn map of a coastal area, possibly a bay or inlet, with various land parcels and water bodies. The map is labeled with numerous codes and abbreviations, including "CRE", "LE", "CR", "LEC", "CRB", "CRU", "CRF", "CRG", "CRH", "CRJ", "CRK", "CRL", "CRM", "CRN", "CRO", "CRP", "CRQ", "CRS", "CRT", "CRV", "CRW", "CRX", "CRY", "CRZ", "CR1", "CR2", "CR3", "CR4", "CR5", "CR6", "CR7", "CR8", "CR9", "CR10", "CR11", "CR12", "CR13", "CR14", "CR15", "CR16", "CR17", "CR18", "CR19", "CR20", "CR21", "CR22", "CR23", "CR24", "CR25", "CR26", "CR27", "CR28", "CR29", "CR30", "CR31", "CR32", "CR33", "CR34", "CR35", "CR36", "CR37", "CR38", "CR39", "CR40", "CR41", "CR42", "CR43", "CR44", "CR45", "CR46", "CR47", "CR48", "CR49", "CR50", "CR51", "CR52", "CR53", "CR54", "CR55", "CR56", "CR57", "CR58", "CR59", "CR60", "CR61", "CR62", "CR63", "CR64", "CR65", "CR66", "CR67", "CR68", "CR69", "CR70", "CR71", "CR72", "CR73", "CR74", "CR75", "CR76", "CR77", "CR78", "CR79", "CR80", "CR81", "CR82", "CR83", "CR84", "CR85", "CR86", "CR87", "CR88", "CR89", "CR90", "CR91", "CR92", "CR93", "CR94", "CR95", "CR96", "CR97", "CR98", "CR99", "CR100". A blue line runs diagonally across the map, possibly indicating a boundary or a specific feature. The map is drawn on a grid of latitude and longitude lines. The coastline is irregular, with many small inlets and peninsulas. The land parcels are outlined with black lines and filled with various patterns, including hatching and stippling. The water bodies are left white. The map is labeled with "C6" in the top left corner and "C7" in the top right corner. The map is drawn on a piece of paper with a grid of latitude and longitude lines. The coastline is irregular, with many small inlets and peninsulas. The land parcels are outlined with black lines and filled with various patterns, including hatching and stippling. The water bodies are left white. The map is labeled with "C6" in the top left corner and "C7" in the top right corner.



**Appendix 2** Marked Crested Auklets resighted at moderate density plots A, B, C, D at Gareloi Island in 2009.

BAND COMBINATIONS RESIGHTED PRE-MANIPULATION (right/right, left)								
	Aa	Ab	Ba	Bb	Ca	Cb	Da	Db
1	bk/dg, y	bk/bk, w	bk/w, bk	bk/dg, r	bk/bk, db	bk/bk, lg	bk/db, o	bk/bk, dg
2	bk/o, db	bk/o, gy *	db/db, db	db/o, y	bk/dg, db	bk/dg, lg	bk/o, w	bk/db, w
3	bk/o, gy *	bk/r, dg	lg/lg, lg *	db/r, db	bk/dg, o	bk/r, y	bk/r, o	bk/lg, lg
4	bk/w, w	bk/y, y	o/db, y	dg/bk, o	bk/o, dg	db/db, lg	bk/r, o	bk/o, r
5	db/bk, y	db/bk, o	o/o, db	dg/o, r	bk/w, r	db/lg, r	bk/w, gy	bk/o, y
6	db/db, y	db/dg, w	o/o, lg	dg/r, w	db/db, o	db/y, db	bk/y, gy	bk/r, y
7	db/dg, db	db/o, db *	o/o, o	dg/w, dg	db/y, y	dg/dg, bk	bk/y, w	db/bk, w
8	db/lg, w	db/w, bk	r/db, lg	lg/lg, lg *	db/bk, y	dg/lg, r	db/lg, dg	db/db, dg
9	db/o, db *	dg/bk, dg	r/db, w	o/dg, bk	dg/o, dg *	dg/o, dg *	lg/db, gy	db/dg, o
10	db/r, dg	dg/dg, lg	r/dg, db	o/lg, gy	dg/o, y	dg/o, o	lg/o, y *	db/o, o
11	db/w, o	dg/o, gy	r/lg, r	o/o, w	dg/w, w	dg/r, y	o/bk, lg	db/r, o
12	db/y, dg	dg/r, r	r/o, r	o/o, y	lg/bk, db *	dg/w, o	o/bk, y *	db/y, bk
13	dg/dg, y	dg/w, y	r/r, dg	o/r, dg	lg/lg, dg	lg/bk, db *	r/bk, o *	db/y, o
14	dg/lg, db	lg/bk, r	r/r, o	o/y, gy	lg/w, gy *	lg/w, gy *	r/db, y	dg/db, gy
15	dg/w, r	lg/db, dg	r/r, y	r/bk, db	o/lg, r	o/lg, bk	r/lg, w	dg/dg, o
16	dg/y, y	lg/db, w *	r/w, r	r/dg, w	o/o, gy	o/y, dg	w/dg, dg	dg/lg, dg
17	lg/db, w *	lg/dg, y	w/r, dg	r/dg, y	o/r, w	w/bk, lg	w/dg, r	dg/o, db
18	o/bk, bk *	o/bk, w	w/w, r	r/lg, db	o/y, w	w/db, gy	w/o, lg	dg/r, o
19	o/bk, r	lg/o, o	w/w, y	r/o, lg	r/o, w	y/w, y	w/w, db	lg/dg, dg
20	o/db, o *	lg/r, r	y/db, lg	r/y, dg	w/bk, r	bk/gy, gy	y/bk, dg	lg/o, y *
21	o/dg, y	lg/w, db	y/dg, y	r/y, gy	w/db, o	bk/gy, lg	y/w, lg	o/bk, w
22	o/y, r	o/bk, bk*	y/r, lg	w/bk, bk	w/o, o	lg/gy, bk	y/y, lg	o/bk, y *
23	r/db, db	o/db, o	o/gy, gy	w/dg, y	y/bk, db	lg/gy, dg		o/db, w
24	r/dg, bk	o/dg, r	gy/gy, y	w/lg, gy	y/dg, o	lg/gy, w		o/dg, db
25	r/lg, lg	o/lg, db		w/r, lg	y/r, dg	o/gy, o *		o/dg, dg
26	r/r, db	o/r, y		w/w, lg	bk/gy, r	w/gy, o		o/lg, o
27	r/y, lg	o/w, db		y/db, dg	lg/gy, o	w/gy, y		o/lg, w
28	w/bk, dg	r/bk, lg		y/dg, r	lg/gy, r	y/gy, bk		o/o, dg
29	w/bk, r	r/bk, r		y/o, gy	lg/gy, y	y/gy, o		o/o, r
30	w/db, r	r/o, dg		y/o, y	o/gy, o *			o/r, gy
31	w/dg, lg	r/r, w		gy/w, db	o/gy, r			o/w, dg
32	w/dg, w	r/w, y		gy/w, o	o/gy, w			o/w, o
33	w/r, y *	w/lg, y		dg/gy, w	r/gy, lg			o/y, bk
34	w/w, dg *	w/o, db		w/gy, w	r/gy, w			o/y, db
35	y/db, bk *	w/r, y *			r/gy, y			o/y, y
36	y/o, dg	w/w, dg *			w/gy, lg			r/bk, bk
37	y/r, db	w/y, db			y/gy, w			r/bk, o *
38	y/y, y	y/bk, y						r/dg, o
39	gy/o, dg	y/db, bk *						r/lg, gy
40	gy/r, r	y/lg, lg						r/lg, y
41	gy/w, r	y/r, w						r/o, o
42		gy/bk, bk						r/w, db
43		gy/db, r						r/w, dg
44		gy/o, db						r/w, w
45		gy/o, o						r/y, db
46		gy/o, r						r/y, y
47		gy/r, bk						w/bk, gy
48		gy/r, gy						w/bk, y
49		gy/r, o						w/db, bk
50		gy/y, gy						w/dg, bk
51		gy/y, o						w/dg, o
52		gy/y, r						w/r, w
53		gy/y, y						w/y, r
54								y/bk, r
55								y/db, db
56								y/dg, w
57								y/lg, gy
58								y/lg, y
59								y/o, db
60								y/o, r
61								y/r, o
62								y/w, lg *
63								y/y, dg
64								
65	* Combination resighted in both halves of the plot							



Plot Half	# CRAU	timestamp
Aa	33	07/07/09 01:55 PM
Ab	16	07/07/09 01:15 PM
Ba	18	07/07/09 10:30 AM
Bb	36	07/07/09 03:15 PM
Ca	5	07/05/09 01:10 PM
Cb	8	07/07/09 02:55 PM
Da	9	07/13/09 01:40 PM
Db	18	07/09/09 03:05 PM